

TWO NEW SPECIES OF *MARPHYSA* QUATREFAGES, 1865 (EUNICIDAE, POLYCHAETA) FROM INTERTIDAL SANDY BEACHES OF THE SÃO SEBASTIÃO CHANNEL, STATE OF SÃO PAULO (BRAZIL)

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ABSTRACT

This paper reports the presence of two new species of *Marphysa* from São Sebastião Channel, State of São Paulo, Brazil, *M. sebastiana* n. sp. and *M. formosa* n. sp., both collected from intertidal sandy beaches. These species belong to the group of *Marphysa* that has branchiae scattered over an extensive region of the body and parapodia with both compound falcigerous and spinigerous chaetae. Comparisons between the two new species and *M. digitibranchia* Hoagland, 1920, *M. orensanzi* Carrera-Parra and Salazar-Vallejo, 1998, *Marphysa* sp. B (Gardiner, 1975), and *Marphysa* sp. (Winsnes, 1989) are presented.

Marphysa sebastiana n. sp. and *M. formosa* n. sp. are both common in samples from São Sebastião Channel, State of São Paulo, Brazil, collected during an investigation of polychaete biodiversity. This project is part of an extensive program to survey the intertidal benthic macrofauna intended to provide a basis for monitoring and subsequent evaluation of ecological impacts, mainly from domestic sewage and oil spills, which are relatively common in this area.

Fauchald (1970) grouped the species of the genus *Marphysa* based on the presence or absence of the compound spinigers and falcigers and the distribution of the branchiae. His group D2 is composed of species having both falcigerous and spinigerous composite chaetae and branchiae scattered over an extensive region of the body. Members of this group include *Marphysa depressa* (Schmarda, 1861), *M. fallax* Marion and Bobretzky, 1875, *M. chevalensis* Willey, 1905, *M. digitibranchia* Hoagland, 1920, *M. languida* Treadwell, 1921, *M. dartevellei* Monro, 1936, *M. posterobranchia* Day, 1962, *M. angelensis* Fauchald, 1970, *M. mixta* Fauchald, 1970, *M. mauritanica* Gillet, 1990, *M. orensanzi* Carrera-Parra and Salazar-Vallejo, 1998, *Marphysa* sp. B (Gardiner, 1975), and *Marphysa* sp. (Winsnes, 1989).

Of the species mentioned above, *Marphysa digitibranchia*, *M. orensanzi*, *Marphysa* sp. B, and *Marphysa* sp. have compound falcigers and spinigers on the anterior setigers and only spinigers on the median and posterior setigers, in common with the two new species described herein. *Marphysa fallax*, *M. chevalensis*, *M. dartevellei*, *M. posterobranchia*, *M. angelensis*, and *M. mixta* show another arrangement of falcigers and spinigers chaetae.

According to the original description by Treadwell (1921), the species *M. languida* has both kinds of compound chaetae, but Fauchald (1970) considered it doubtful, and pointing out that the type material of this species was re-examined by Hartman (1956), who noted the absence of compound spinigers. Schmarda (1861) described *M. depressa*, from New Zealand, as having both types of compound chaetae; however, their distribution along the whole body is unclear from his description. Day (1953) redescribed *M. depressa*, which has been reported from South Africa, based on specimens from New Zealand collected by Ehlers in 1907. According to descriptions by Day (1953, 1967), and comments

by Fauchald (1970), *M. depressa* has many falcigers and few spinigers along the whole body. *M. mauritanica* has three antennae, lacks palps, and has been considered by some authors as a young specimen of *Marphysa sanguinea* (Parapar et al., 1993).

MATERIAL

São Sebastião Channel is located between 23°41'S to 23°53,5'S and 45°19'W to 45°30'W. It is 25 km long, with São Sebastião Island to the east and the mainland to the west. The sandy beaches where the specimens were collected are characteristic of the different kinds of intertidal environments found along both sides of the channel: sandy-mud (Barra Velha), sandy-mud mixed with gravel and shell particles (Araçá), fine to very fine sand (Enseada, Cigarras, Grande, Segredo, Barequeçaba), very coarse to medium sand (Pontal da Cruz, Siriúba, Porto Grande, Perequê, Garapocaia), and sand mixed with stones (São Francisco, Engenho d'Água). In addition to the recent samples, some specimens collected between 1992 and 1993 from the same beaches were included in the material examined.

The holotype and paratypes, as well as all the specimens examined are deposited in the polychaete collection (MHN-BPO) of the Museu de História Natural da Universidade Estadual de Campinas/UNICAMP, Campinas, State of São Paulo, Brazil.

SYSTEMATICS

Family Eunicidae Berthold, 1827
Genus *Marphysa* Quatrefages, 1865
***Marphysa sebastiana* new species**
(Figs. 1,2)

Material Examined.—Holotype (MHN-BPO-65) from Barra Velha Beach, 20 May 1996, is about 120 mm long, complete, prostomium 1.5 mm wide, anterior region of body 2.7 mm wide including parapodia, 306 setigers. Paratypes.—Barra Velha Beach: 15 Oct. 1992, 2 spec. (MHN-BPO-65/1, MHN-BPO-65/7); 7 Sept. 1995, 1 spec. (MHN-BPO-65/15); 6 Oct. 1995, 1 spec. (MHN-BPO-65/12 – jaw apparatus removed); 2 Jun. 1996, 1 spec. (MHN-BPO-65/13). São Francisco Beach: 22 Sept. 1995, 1 spec. (MHN-BPO-65/8); 8 Apr. 1996, 1 spec. (MHN-BPO 65/18); 2 Jun. 1996, 1 spec. (MHN-BPO-65/2 – jaw apparatus removed); 25 Jun. 1997, 1 spec. (MHN-BPO-65/16). Araçá Beach: 21 May 1997, 1 spec. (MHN-BPO-65/17); 24 Sept. 1996, 1 spec. (MHN-BPO-65/14); 2 Jun. 1996, 1 spec. (MHN-BPO-65/3). Engenho d'Água Beach: 17 Apr. 1996, 1 spec., (MHN-BPO-65/4); 20 Jan. 1997, 1 spec. (MHN-BPO-65/19). Perequê Beach: 26 Mar. 1993, 2 spec. (MHN-BPO-65/5, MHN-BPO-65/6). Siriúba Beach: 20 Feb. 1996, 2 spec. (MHN-BPO-65/9, MHN-BPO-65/10). Garapocaia Beach: 17 Apr. 1996, 1 spec. (MHN-BPO-65/11). The widest paratype is an incomplete spec. (MHN-BPO-65/2), 78 mm long, prostomium 2 mm wide, anterior region of the body 4.5 mm wide including parapodia, 245 setigers. The longest paratype is an almost complete spec. (MHN-BPO-65/17), 165 mm long, prostomium 1 mm wide, anterior region of body 2.2 wide including parapodia, 403 setigers. The shortest paratype is a complete spec. (MHN-BPO-65/18), 51 mm long, prostomium 1 mm wide, anterior region of body 1.9 mm wide including parapodia, 212 setigers.

Type Locality.—Brazil: State of São Paulo, Municipality of São Sebastião, São Sebastião Channel, intertidal zone.

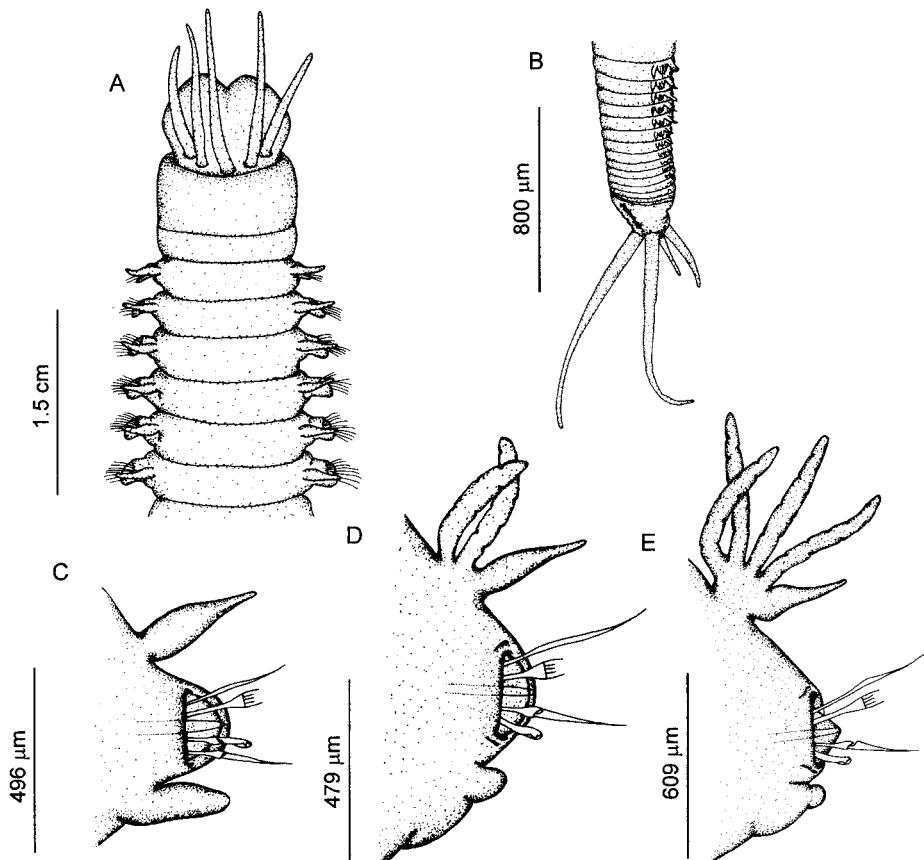


Figure 1. *Marphysa sebastiana*. Holotype: A. anterior end, dorsal view. B. pygidial region. Paratype MHN-BPO-65/2: C. parapodium of setiger 4, D. parapodium of setiger 45, E. parapodium of setiger 55.

Description.—Anterior body segments cylindrical, becoming dorsoventrally flattened posteriorly. Prostomium bilobed anteriorly, as long as first peristomial ring, which is twice as long as second peristomial ring; following setigers slightly longer than second peristomial ring. Three antennae: median almost twice as long as the prostomium, lateral pair of antennae shorter than median antenna. One pair of dorsolateral palps. Antennae and palps smooth, subulate, arranged in a transverse row. Eyes absent. Dorsal cirri cirriform, longer than parapodial lobe, slightly decreasing in length in posterior region of body. Ventral cirri with rounded tips, as long as dorsal cirri in the first 7–10 setigers, becoming gradually cushionlike with a distally small papilla, and decreasing in size toward the end of the body. Long, rounded postchaetal lobe in anterior region, becoming gradually shorter than acicular lobe in median and posterior region. Parapodia with prechaetal lobes always truncate and straight. Branchial tufts in palmate arrangement, emerging from the same stem as the dorsal cirri; beginning on about setigers 20–44 and continuing toward end of the body, with up to 6 filaments, each varying from very short to three times as long as dorsal cirrus. Last 15–25 setigers without branchiae. Supra-acicular bundle of chaetae

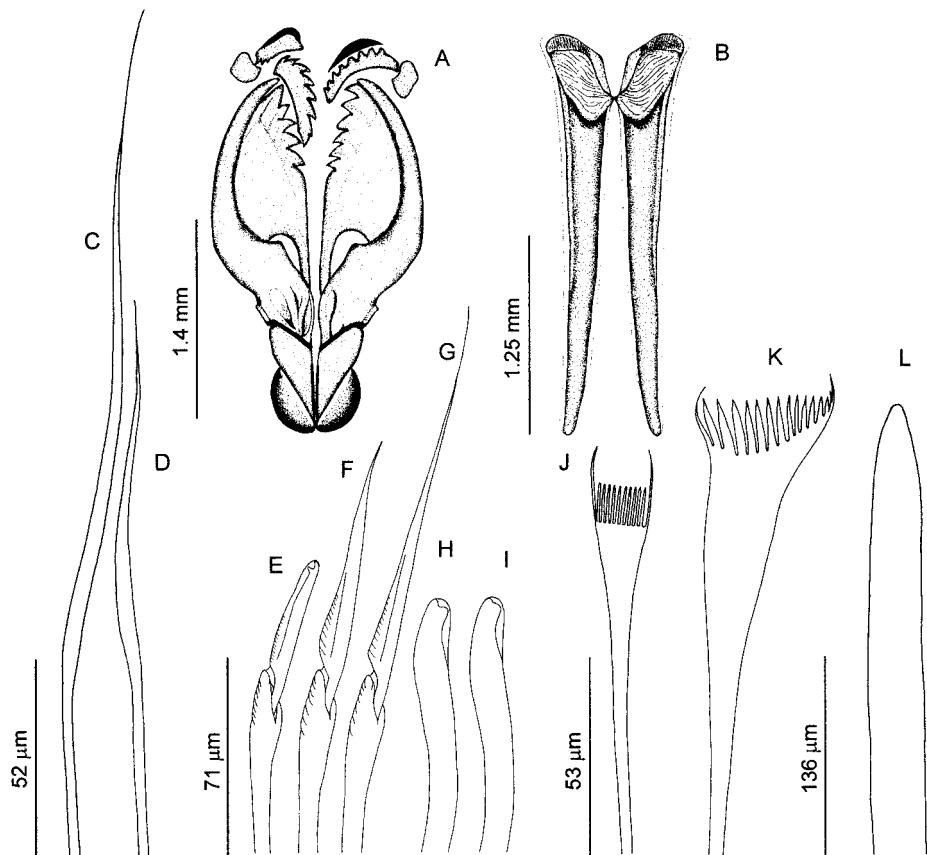


Figure 2. *Marphysa sebastiana*. Paratype MHN-BPO-65/2: A. maxillae, B. mandibles, C. long capillary chaeta, D. short capillary chaetae, E. compound falciger chaetae; F. short spiniger chaetae; G. long spiniger chaetae; H. subaciccular hook from setiger 55, holotype. I. subaciccular hook from setiger 60, paratype MHN-BPO-65/2, J. symmetrical pectinate chaetae from setiger 35, K. asymmetrical pectinate from posterior setigers, L. acicula.

include: (1) up to 12 long, simple, slender capillaries; (2) up to 25 short, simple, slender capillaries; (3) 1–7 symmetrical pectinates, with 8–12 teeth, lateral ones twice as long as others, replaced by asymmetrical pectinates in posteriormost setigers, 16–20 stout teeth. Sub-acicicular bundle of chaetae include: (1) up to 15 compound spinigers with long appendages; (2) up to 40 compound spinigers with short appendages; (3) hooded bidentate compound falcigers, with long appendages, present in most of the first 10–45 setigers, absent in median and posterior setigers; if present, maximum 3–10 per parapodium. Number of chaetae, except pectinate ones, decrease from setigers 25–40 toward the end of the body. Hooded bidentate subaciccular hooks with rounded teeth beginning on setigers 33–52, depending on specimen length, mostly one per parapodium, rarely two, light brown in color. Acicula thick with blunt tips, 3–4 per parapodium, and brown in color on anterior region; 1–2 light brown acicula per parapodium on posterior region. Jaw apparatus dark brown to black, mandibles with subtle rows of light concentric striations on their anterior end. Maxillary formula: I=1+1, II=5+(6-8), III=6+0, IV=(3-5)+(7-8) and a chitinous band,

V=rounded white plates. Pygidium with two pairs of smooth and subulate ventrally pygidial cirri, superior pair almost three times as long as inferior pair. Paratype specimen MHN-BPO-65/4 has the prostomium rounded anteriorly, without the characteristic notch found on other specimens, but the prostomium length and all other characters are within the pattern described. Younger specimens show less chaetae per parapodium. The length of branchiae varied from one specimen to another. In posterior setigers chaetae are shorter. There is not a relationship between number of falcigers per parapodium and body length. Smaller animals have an early appearing of subaciccular hook.

Occurrence.—*M. sebastiana* has been found in sediments varying from sand to mud, sand mixed with stones, and sand mixed with gravel and shell particles. São Sebastião Channel (Enseada, São Francisco, Araçá, Siriúba, Garapocaia, Perequê, Engenho d'Água and Barra Velha Beaches).

Etymology.—The specific name *sebastiana* refers to the species' wide distribution, abundance, and frequency along São Sebastião Channel.

Discussion.—As seen in Table 1, *M. sebastiana* is very similar to *Marpysa* sp. B described by Gardiner (1975). Gardiner's species has faint eyes, whereas the specimens examined here have no eyes. Gardiner did not mention the shape of the pectinate chaetae. The differences between *M. sebastiana* and *Marpysa* sp. B, such as the variation observed at the beginning of the branchiae and hooks, as well as where the falcigerous chaetae end, is considered here as originating from differences in size among the specimens examined. It is possible that both morphs belong to the same species.

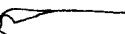
***Marpysa formosa* new species**
(Figs. 3,4)

Material Examined.—Holotype (MHN-BPO-64) from São Francisco Beach, May 21, 1996, is about 55 mm long, complete, prostomium 1.5 mm wide, anterior region of the body 3 mm wide including parapodia, 185 setigers. Paratypes.—São Francisco Beach: 21 May 1996, 2 spec. (MHN-BPO-64/1 – jaw apparatus removed, MHN-BPO-64/3); 3 Jul. 1996, 3 spec. (MHN-BPO-64/10); 5 Oct. 1995, 2 spec. (MHN-BPO-64/4 – jaw apparatus removed, MHN-BPO-64/2); 25 Nov. 1996, 2 spec. (MHN-BPO-64/5, MHN-BPO-64/6); 26 Nov. 1996, 3 spec. (MHN-BPO-64/8, MHN-BPO-64/9); 20 Jan. 1997, 3 spec. (MHN-BPO-64/7). The longest paratype is an incomplete spec. (MHN-BPO-64/1), 43 mm long, prostomium 2.5 mm wide, anterior region of the body 4 mm wide including parapodia, 124 setigers. The shortest paratype is a complete spec. (MHN-BPO-64/8), 19 mm long, prostomium 0.7 mm wide, anterior region of the body 1.1 mm wide including parapodia, 75 setigers.

Type Locality.—Brazil: State of São Paulo, Municipality of São Sebastião, São Sebastião Channel, intertidal zone.

Description.—Anterior body segments cylindrical, posteriorly becoming dorsoventrally flattened. Prostomium bilobed anteriorly, longer than first peristomial ring. Three antennae: median almost twice as long as prostomium length; lateral pair shorter than median. One pair of dorsolateral palps inserted anterior to antennae. Antennae and palps smooth and subulate, arranged in horseshoe. One pair of round black eyes, well visible and located behind palps. First peristomial ring 1.5 times as long as second peristomial ring. Following setigers shorter than second peristomial ring. Dorsal cirri with rounded tips in

Table 1. Comparison of *Marpophysa* sp. B (Gardiner, 1975) and *Marpophysa sebastiana*.

Species	Measurements (mm)	Distribution	Prostomium and peristomium	Branchiae (closely related to dorsal cirrus) Length (in relation to dorsal cirrus)	Number of filaments (beginning)	Setae	Falcigers (ending)	Pectinates	Hook (beginning)	Acicula		Maxillæ (Color)	
										Anterior	Posterior		
<i>Marpophysa</i> sp. B (Gardiner, 1975)	185 long 3.5 wide	North Carolina, USA		1.4 (24-43)	3 times			simple ?			3-4 (32-52)	1-2 dark brown to black	I = 1+1 II = 4+5 III = 6+0 IV = 34+78 V = plates
<i>M. sebastiana</i> n. sp.	20-78 long 2-4.5 wide	São Sebastião, São Paulo, Brazil		1.6 (20-44)	up to 2 times					3-4 (45)	1-2 light brown	yellow (33-52)	(dark brown) I = 1+1 II = 5+6/8 III = 6+0 IV = 3/5+7/8 V = plates

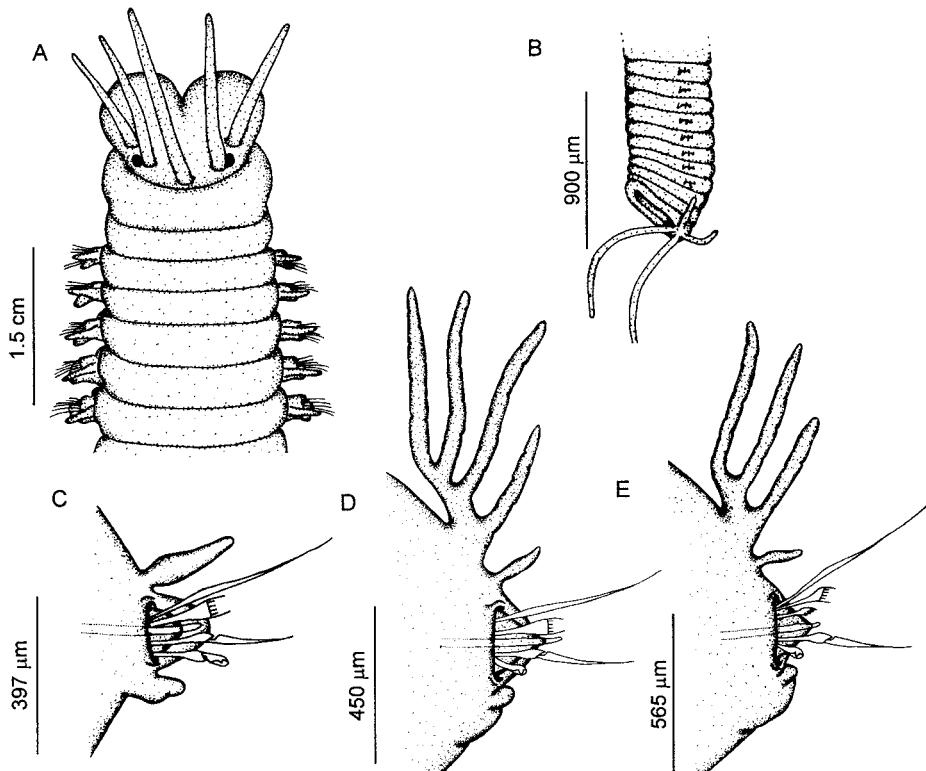


Figure 3. *Marphysa formosa*. Holotype: A. anterior end, dorsal view, B. pygidial region. Paratype MHN-BPO-64/2: C. parapodium of setiger 4, D. parapodium of setiger 45, E. parapodium of setiger 90.

anterior setigers, outreaching parapodial lobes, becoming short and slender toward end of the body. Ventral cirri with rounded tips, shorter than dorsal cirri, becoming gradually cushionlike with a distally small papilla and decreasing in size toward the end of the body. Parapodia with truncate prechaetal lobes, conical acicular lobes; postchaetal lobes longer than acicular lobes, decreasing gradually in length along median and posterior region. Branchial pectinate tufts emerging from a stem separately from dorsal cirrus and at a certain distance from it; first branchiae on about setigers 14–29, depending on the specimen length, with up to 4 filaments and continuing posteriorly nearly to the end. Last 9–15 setigers without branchiae. Branchial filaments in pectinate arrangement, well separated between themselves; up to five times as long as dorsal cirrus. Supra-acicular bundle of chaetae include: (1) 1–3 long, simple, slender capillaries; (2) 2–8 short, simple, slender capillaries; (3) 1–6 symmetrical pectinates with 18–22 teeth, lateral ones three times as long as others, up to 12 from setigers 45–50; (4) asymmetrical pectinates with outer teeth three times as long as inner teeth from setigers 30–50; (5) asymmetrical pectinates with stout teeth, all of teeth equal in length and directed laterally, from setigers 30–50. Sub-acicular bundle of chaetae include: (1) up to 4 compound spinigers with short appendages; (2) up to 18 compound spinigers with long appendages, decreasing in number from setigers 25–40 toward the end of the body; (3) hooded bidentate compound falcigers,

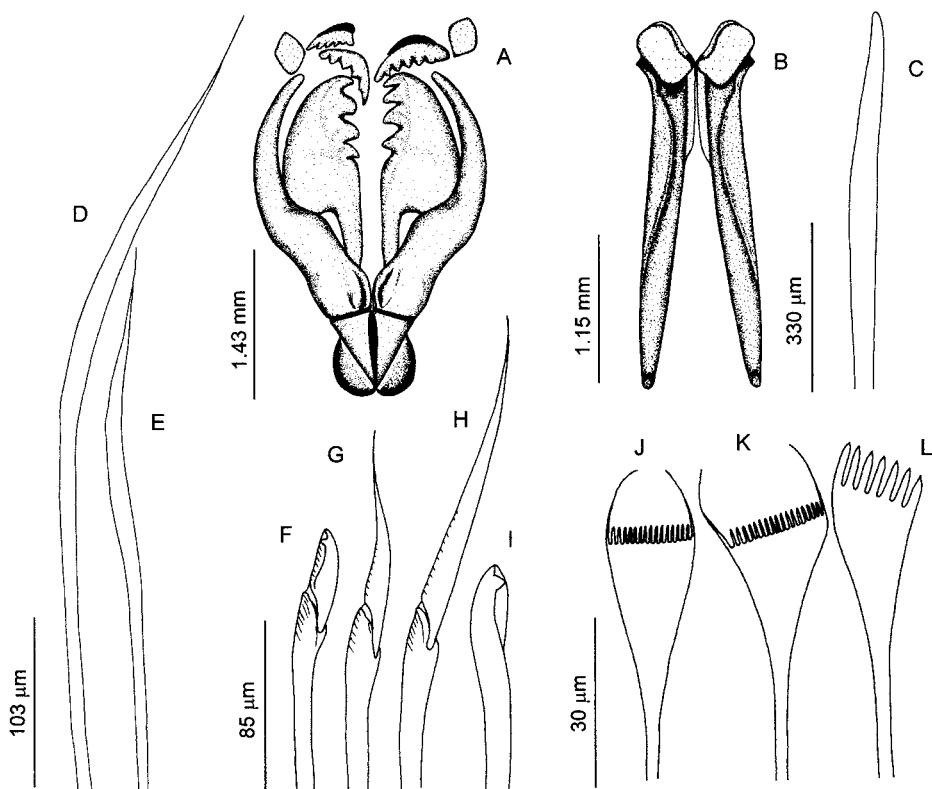


Figure 4. *Marphysa formosa*. Paratype MHN-BPO-64/4: A. maxillae, B. mandibles, C. Acicula, D. long capillary chaetae, E. short capillary chaetae, F. compound falciger chaetae; G. short spiniger chaetae; H. long spiniger chaetae; I. subacicicular hook, J. symmetrical pectinate chaetae, K,L. asymmetrical pectinate from posterior setigers.

with short appendages, present in most of the first 10–25 setigers, then disappearing; if present, maximum 2–6 per parapodium. Hooded bidentate subacicicular hooks beginning on setigers 22–38, depending on specimen length, one per parapodium, rarely two, light brown in color. Acicula stout, slightly curved, 2–3 per parapodium on anterior region and 1–2 light brown on rest of body. Jaw apparatus dark brown to black, mandibles with white plate on their anterior end. Maxillary formula: I=1+1, II=4+4, III=5+0, IV=6+7 and a chitinous band, V= rounded white plates. Pygidium with two pairs of smooth and subulate ventrally pygidial cirri, superior pair four times as long as inferior pair. The length of branchiae varied from one specimen to another. In posterior setigers chaetae are shorter. There is not a relationship between number of falcigers per parapodium and body length. Smaller animals have an early appearing of subacicicular hook.

Occurrence.—*M. formosa* occurred on São Francisco Beach. It was also found on Barra Velha Beach but specimens were not available. Both beaches have poorly sorted sediments and a high level of organic enrichment.

Etymology.—The specific name *formosa* was chosen for this species' slender shape and daintiness.

Table 2. Comparison of *Marpophysa formosa* with allied species.

Species	Measurements (mm)	Distribution	Prostomium and peristomium	Branchiae Closely related to dorsal cirrus (Y/N)	Length (in relation to dorsal cirrus Y/N)	Spinigers (beginning)	Setae	Falcigers (ending)	Pectinates	Hook (beginning)	Acicula	Maxillae (Color)
										Anterior	Posterior	
<i>Marpophysa digitibranchia</i>	20 long 2 wide	China Sea, near Hong Kong		1-5 (20)	?	almost 2 times					2 dark brown, 1 light	1 dark brown
<i>M. orensanzi</i>	12 long 2 wide	Shallow rocky bottom (between algae) Mexico		1-2 (13)	?	3 times					2-3 transparent	1 transparent
<i>Marpophysa</i> sp. (Winsnes, 1989)	50 long 3.9 wide	Coast of Sweden		1-2 (15)	Y	3 times					3-4 dark	1-2 dark
<i>M. formosa</i> n. sp.	31-65 long 1.5-6 wide	São Sebastião, São Paulo, Brazil		poorly developed							2-3 dark brown (22-38) yellow	1-2 light brown

(light brown)
I = 1+1
II = 5+6
III = 5(6+0
IV = ?
V = ?

I = 1+1
II = 4+4
III = 5+0
IV = 3+6
V = plates

I = 1+1
II = 5+6
III = 5(6+0
IV = ?
V = ?

DISCUSSION

Table 2 shows how *M. formosa* differs from other allied species. *M. digitibranchia* Hoagland 1920, from the China Sea near Hong Kong, was described as having two subaciccular hooks per parapodium, the acicula dark brown on posterior setigers, short antennae, and maxilla I with a long basal support; all features in contrast to those in *M. formosa*. *M. orensanzi* Carrera-Parra and Salazar-Vallejo 1998 (originally described from one specimen) has transparent acicula, branchiae with 1–2 filaments, only one kind of pectinate chaetae, short antennae, and is found on shallow rocky bottoms among algae. Furthermore, *M. orensanzi* has a short wide body, whereas *M. formosa* is longer. *Marphysa* sp. described by Winsnes (1989) has tridentate compound falcigers, only 3–4 per parapodium, short antennae and a large pectinate chaeta with short teeth.

COMPARISONS BETWEEN *M. SEBASTIANA* AND *M. FORMOSA*.—Although closely related, the two new species show certain similarities in the distribution pattern of those structures most commonly used in the systematics of the family. There are important differences between them: the arrangement of the antennae and palps on the prostomium, length of the first peristomial ring, presence or absence of eyes, shape of the dorsal cirrus, relationship between the dorsal cirrus and the branchial stem, length of the appendages of the compound falcigers, shape of the subaciccular hooks, length of the pectinate teeth, arrangement of the branchial filaments, shape of the jaw apparatus and number of teeth of the maxillae. *M. formosa* has two kinds of asymmetrical pectinate chaetae, which are absent in *M. sebastiania*. The latter species has many more chaetae in general and more falcigerous chaetae per parapodium, and the branchiae and hooks start more posteriorly on the body, for a given body-size.

M. sebastiania occurred on eight of the 14 beaches studied. *M. formosa* occurred on only two beaches, both with poorly sorted sediments and a high level of organic enrichment.

In order to justify separation of these two species, we took into account not only the presence or absence of morphological structures, but their shape and length, as well as number of chaetae, in view of the extensive and constant variation of the characters of both species. Features such as shape and teeth length of the pectinate chaetae, number of chaetae per parapodium, as well as other characters which have not been emphasized in many other descriptions of species of this genus, may be of taxonomic value.

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LITERATURE CITED

- Carrera-Parra, L. F. and S. I. Salazar-Vallejo. 1998. A new genus and 12 new species of Eunicidae (Polychaeta) from the Caribbean Sea. *J. Mar. Biol. Ass. U.K.* 78: 145–182.
Day, J. H. 1953. The polychaete fauna of South Africa. Part 2: Errant species from Cape shores and estuaries. *Ann. Natal Mus.* 12: 397–441.
_____. 1962. Polychaeta from several localities in the Western Indian Ocean. *Zool. Soc. Lond., Proc.* 139: 627–656.

- _____. 1967. Polychaeta of Southern Africa. Part 1. Errantia and Part 2. Sedentaria. Brit. Mus. (Nat. Hist.), Lond. Publ.: 1–656.
- Fauchald, K. 1970. Polychaetous Annelids of the families Eunicidae, Lumbrineridae, Iphitimidae, Arabellidae, Lysaretidae and Dorvilleidae from Western Mexico. Allan Hancock Monogr. Mar. Biol. 5: 1–335.
- Gardiner, S. L. 1975. Errant polychaete annelids from North Carolina. J. Elisha Mitchell Sci. Soc. 91: 77–220.
- Gillet, P. 1990. Note sur les annélides polychètes du Banc D'Arguin (Mauritanie) et description de *Marphysa mauritanica* n. sp. Beaufortia 40: 73–84.
- Hartman, O. 1956. Polychaetous annelids erected by Treadwell, 1891 to 1948, together with a brief chronology. Bull. Amer. Mus. Nat. Hist. 109: 239–310.
- Hoagland, R. A. 1920. Polychaetous annelids collected by the United States Fisheries Steamer ALBATROSS during the Philippine expedition of 1907–1909. Bull. U.S. Nat'l. Mus. 100: 603–634.
- Marion, A. F. and N. Bobretzky. 1875. Étude des annélides du Golfe de Marseille. Ann. Sci. Nat. Paris 6: 1–106.
- Monro, C. C. A. 1936. Notes on some Polychaeta from the Congo coast. Ver. Zool. Bot. Afr. 28: 245–248.
- Parapar, J., C. Besteiro and V. Urgorri. 1993. Aportaciones a la taxonomía y autoecología de los anélidos de la Península Ibérica: poliquetos de la Ría de Ferrol. Cah. Biol. Mar. 34: 411–432.
- Schmarda, L. K. 1861. Neue wirbellose Thiere beobachtet und gesammelt auf einer Reise um die Erde 1853 bis 1857. vol. 1 Turbellarien, Rotatorien und Anneliden. Pt. 2, pages 1–164, Leipzig.
- Treadwell, A. L. 1921. Leodicidae of the West Indian Region. Carnegie Inst. Wash. Publ. no. 293. 131 p.
- Willey, A. 1905. Report on the Polychaeta collected by Professor Herdman, at Ceylon in 1902. Rep. Ceylon Pearl Oyster Fish. Suppl. 4: 243–324.
- Winsnes, I. M. 1989. Eunicid polychaetes (Annelida) from Scandinavian and adjacent waters. Family Eunicidae. Zool. Scrip. 18: 483–500.

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